

series of ephemerides, nor do I think it a very important thing that the precepts concerning time in our books on practical astronomy should be changed. Changes occur in other branches of science which necessitate more important alterations in the respective books, and they are made in new editions without the least confusion arising. I think that generally we are more inclined to *over* than to *under* estimate the trouble of a transition period; and I think the uniformity of astronomical and civil reckoning is surely worth the little trouble we shall have to overcome, at the beginning of the change, until the new reckoning is firmly rooted in all minds.

On the Right Ascensions of the Cape Catalogues for 1850 and 1880.
By A. M. W. Downing, M.A.

In the Introduction to the Cape Catalogue for 1850 Mr. Gill gives a comparison between the R.A.'s of that Catalogue and of the Cape Catalogue for 1880. From this it appears that there is a considerable discordance between the R.A.'s of these Catalogues depending on N.P.D. From certain other comparisons which he makes Mr. Gill concludes that the results of the Dollond Transit Instrument (contained in the 1850 Catalogue) may be accepted with considerable confidence, and appears to consider that the discordance in question is probably due to variation in the plane of collimation in the Cape Transit Circle at different altitudes, and that therefore the discordances between the R.A.'s of the 1850 and 1880 Catalogues arise from errors in the latter. Without wishing to enter into any controversy on the subject, I desire to lay before the Society some evidence, taken from comparisons of southern catalogues which I happened to have by me, which appears to throw some light on this matter. And first for the Cape Catalogues for 1850 and 1880. I have made use of the materials on pp. viii and ix of the Introduction to the 1850 Catalogue, taking the mean differences of R.A. for every 6° of N.P.D. I thus obtain the following mean differences:—

Mean N.P.D.	Mean $\Delta\alpha$ 1880—1850.	Number of Stars.	Mean N.P.D.	Mean $\Delta\alpha$ 1880—1850.	Number of Stars.
92 55	^s —0°007	144	141 0	^s —0°164	313
98 51	— 0°026	139	147 1	— 0°080	296
104 58	— 0°027	112	151 42	— 0°062	245
112 5	— 0°056	147	158 43	— 0°064	188
116 51	— 0°079	502	164 46	— 0°027	77
122 37	— 0°100	393	170 14	+ 0°084	58
129 4	— 0°131	358	176 38	— 0°347	15
134 55	— 0°149	381			

The weighted mean difference (without reduction to the equator) is $-0^s.090$, and the total number of stars used is 3368.

By a graphical representation of these mean differences, and drawing a curve through them, the following were obtained by reading off from the curve for every 5° of N.P.D.

N.P.D.	$\Delta\alpha$	N.P.D.	$\Delta\alpha$
	^s		^s
95	$-0^s.013$	135	$-0^s.149$
100	$-0^s.021$	140	$-0^s.161$
105	$-0^s.032$	145	$-0^s.103$
110	$-0^s.048$	150	$-0^s.078$
115	$-0^s.070$	155	$-0^s.060$
120	$-0^s.091$	160	$-0^s.042$
125	$-0^s.113$	165	$-0^s.025$
130	$-0^s.134$		

Thus a notable discordance depending on N.P.D. is made manifest, ranging from $-0^s.013$ at 95° to $-0^s.161$ at 140° .

I take next the Cape Catalogues for 1840 and 1850. By bringing up the places of the stars which are common to these two Catalogues from 1840 to 1850, using the proper motions given in the former Catalogue, or, wherever possible, those of the Cape Catalogue for 1880, and then taking the differences, and combining these differences in groups of (generally) 5° of N.P.D., we obtain the following mean differences:—

Mean N.P.D.	Mean $\Delta\alpha$ 1840-1850.	Number of Stars.	Mean N.P.D.	Mean $\Delta\alpha$ 1840-1850.	Number of Stars.
	^s			^s	
42 4	$+0^s.047$	3	117 5	$-0^s.011$	87
56 15	$+0^s.030$	3	122 7	$-0^s.016$	85
62 4	$-0^s.008$	6	127 24	$-0^s.045$	111
67 45	$-0^s.009$	12	132 37	$-0^s.049$	127
72 19	$+0^s.064$	7	137 54	$-0^s.070$	83
77 32	$+0^s.009$	12	141 55	$-0^s.062$	77
82 25	$+0^s.031$	19	147 43	$-0^s.075$	83
86 21	$+0^s.038$	11	152 26	$-0^s.050$	58
91 48	$-0^s.005$	11	157 39	$-0^s.110$	67
97 59	$+0^s.044$	15	162 20	$-0^s.072$	39
102 34	$+0^s.024$	17	167 24	$-0^s.164$	28
107 14	$+0^s.022$	43	174 0	$+0^s.028$	18
112 34	$-0^s.013$	68			

The weighted mean is $-0^s.041$ ($-0^s.025$ from 80° to 140°), and the total number of stars is 1090. By proceeding exactly as in the preceding case, the reduction curve gives:—

N.P.D.	$\Delta\alpha$	N.P.D.	$\Delta\alpha$
	^s		^s
75	+ 0'027	120	- 0'020
80	+ '027	125	- '032
85	+ '027	130	- '047
90	+ '021	135	- '061
95	+ '023	140	- '067
100	+ '029	145	- '067
105	+ '021	150	- '068
110	+ '004	155	- '078
115	- 0'011	160	- 0'093

In this case also we have a considerable discordance depending on N.P.D.

The next two Catalogues compared are the Cape Catalogue for 1880 and the Melbourne Catalogue for 1870. Proceeding exactly as in the preceding case, we have the following mean differences in R.A.:—

Mean N.P.D.	Mean $\Delta\alpha$ 1880-1870	Number of Stars.	Mean N.P.D.	Mean $\Delta\alpha$ 1880-1870	Number of Stars.
	^s			^s	
44 38	+ 0'015	2	117 28	- 0'040	37
51 11	'000	2	122 13	- '030	36
57 41	- '020	4	127 28	- '021	68
62 9	+ '013	10	132 7	+ '007	71
67 57	'000	9	137 23	- '048	60
72 6	- '003	8	141 50	- '040	33
77 3	+ '033	12	147 55	+ '017	45
82 36	+ '011	16	152 31	- '001	209
87 17	'000	9	157 46	- '058	130
91 45	+ '001	14	161 55	- '077	20
97 59	- '006	7	168 8	- '116	29
102 54	- '018	6	172 39	+ '002	42
107 27	- '031	11	177 1	- 0'074	15
113 15	- 0'041	10			

The combined mean difference is $-0^s.021$, and the total number of stars used in the comparison is 915.

By reading off from the reduction curve for every 5° , we have:—

N.P.D.	$\Delta\alpha$ ^s	N.P.D.	$\Delta\alpha$ ^s
50	0.000	115	-0.038
55	- .007	120	- .036
60	- .002	125	- .025
65	+ .003	130	- .014
70	+ .004	135	- .026
75	+ .013	140	- .033
80	+ .017	145	- .013
85	+ .009	150	- .005
90	.000	155	- .024
95	- .005	160	- .069
100	- .014	165	- .083
105	- .025	170	- .067
110	-0.037	175	-0.063

The comparison of the R.A.'s of these Catalogues is very satisfactory, as, except in the immediate neighbourhood of the Pole, the discordances are small, and the range confined within reasonable limits.

In order to compare the R.A.'s of the Cape Catalogue for 1880 and 1860, I have made use of the comparison between the R.A.'s of Melbourne (1870) and Cape (1860), arranged in order of N.P.D., given by De Ball in his paper, "Untersuchungen über die eigene Bewegung des Sonnensystems," p. 3, and applying this to the values of $\Delta\alpha$ (1880-1870) given above, we have:—

N.P.D.	$\Delta\alpha$ (1880-1860) ^s	N.P.D.	$\Delta\alpha$ (1880-1860) ^s
60	-0.002	115	-0.018
65	- .007	120	- .016
70	- .006	125	+ .005
75	+ .003	130	+ .036
80	+ .007	135	+ .034
85	- .001	140	+ .057
90	.000	145	+ .087
95	+ .005	150	+ .105
100	- .004	155	+ .076
105	- .015	160	+ .031
110	-0.027	165	+0.017

Here again we have a considerable range in the discordances in R.A. depending on N.P.D.

By means of these various comparisons we have the materials for comparing the R.A.'s of each of the two Catalogues under consideration—viz. those for 1850 and 1880—with the mean of three other Catalogues. Thus we have comparisons of the R.A.'s of the 1880 Catalogue with those of Melbourne (1870) and Cape (1860); and also with those of Cape (1840) indirectly, by

means of the Cape Catalogue for 1850. Similarly we have the R.A.'s of the 1850 Catalogue compared directly with those of Cape (1840) and indirectly (through the comparison with the 1880 Catalogue), with those of Melbourne (1870) and Cape (1860). We thus find the following comparison of the R.A.'s of the Cape Catalogues for 1850 and 1880 with the mean of the three other Catalogues, arranged in order of N.P.D. :—

N.P.D.	$\frac{\Delta\alpha}{s}$ (1880-Mean).	$\frac{\Delta\alpha}{s}$ (1850-Mean).	N.P.D.	$\frac{\Delta\alpha}{s}$ (1880-Mean).	$\frac{\Delta\alpha}{s}$ (1850-Mean).
60	-0'002		115	-0'038	+0'032
65	- '002		120	- '041	+ '049
70	- '001		125	- '034	+ '079
75	+ '008		130	- '022	+ '112
80	+ '012		135	- '027	+ '122
85	+ '004		140	- '023	+ '138
90	'000		145	+ '013	+ '116
95	- '012	+ 0'001	150	+ '030	+ '108
100	- '023	- '002	155	+ '023	+ '083
105	- '031	+ '001	160	+ 0'005	+ 0'046
110	-0'039	+ 0'009			

As tried by this test the R.A.'s of the Catalogue for 1880 appear to be much superior to those of the Catalogue for 1850. It may, however, be objected that this comparison is unduly favourable to the 1880 Catalogue, as, if systematic discordances, arising from uncorrected proper motions, affect the comparison of the Catalogues for 1850 and for 1880 to any appreciable extent, they would affect the comparison of the 1850 Catalogue with the mean considerably more than that of the 1880 Catalogue. Although I do not think that, considering the large number of stars used in the comparison (more than 3000), there can be any considerable outstanding systematic discordance arising from the use of erroneous proper motions; still, in deference to the opinion which has been expressed on the subject, I have made a comparison of the R.A.'s of the two Catalogues with the mean of the Cape Catalogues for 1840 and 1860, thus meeting the objection referred to above. The result is as follows :—

N.P.D.	$\frac{\Delta\alpha}{s}$ (1880-Mean).	$\frac{\Delta\alpha}{s}$ (1850-Mean).	N.P.D.	$\frac{\Delta\alpha}{s}$ (1880-Mean).	$\frac{\Delta\alpha}{s}$ (1850-Mean).
95	-0'016	-0'003	130	-0'026	+0'109
100	- '027	- '006	135	- '027	+ '122
105	- '034	- '002	140	- '019	+ '143
110	- '040	+ '009	145	+ '026	+ '129
115	- '039	+ '032	150	+ '048	+ '126
120	- '044	+ '046	155	+ '047	+ '107
125	-0'038	+ 0'075	160	+ 0'042	+ 0'083

Although the range of discordances in R.A. depending on N.P.D. is somewhat increased for the 1880 Catalogue by this proceeding, it still shows its superiority to the 1850 Catalogue. The extreme range for the former being from $-0^s.044$ at N.P.D. 120° to $+0^s.048$ at N.P.D. 150° , and for the latter from $-0^s.006$ at N.P.D. 100° to $+0^s.143$ at N.P.D. 140° . It appears, therefore, that, as far as this evidence goes, errors in the R.A.'s of the Cape Catalogue for 1850 are the principal cause of the discordances in R.A. depending on N.P.D. which appear in the comparison of the R.A.'s of the Cape Catalogues for 1850 and 1880.

Attention may also be called to the discordances between the R.A.'s of the 1840 and 1850 Catalogues when the same instrument was used; and also to the discordances between the R.A.'s of the 1860 and 1880 Catalogues, where again the same instrument was used. It would appear, therefore, that the discordances between the 1850 and 1880 Catalogues are not necessarily due to any cause arising from the use of a different instrument in making the observations.

It may be remarked that the discordances in R.A. given in this paper throughout are the actual discordances at the respective N.P.D.'s, without reduction to the equator.

On the Star Places of the Nautical Almanac.
By A. M. W. Downing, M.A.

In the *Nautical Almanac* for 1884 a change is introduced in the sources from whence the places of the Greenwich fundamental stars are taken. The mean Right Ascensions of 182* stars have been derived (as we are informed in the Preface to the *Nautical Almanac* for 1884) from (1) the table, pp. 21–22, of the Greenwich Nine-Year Catalogue; (2) the Greenwich Clock-star List for 1879; (3) the Nine-Year Catalogue itself. The mean Declinations have been brought up from the Nine-Year Catalogue, including the corrections of table, p. 27. It appears, therefore, that the Right Ascensions of those stars which are used as clock stars at Greenwich are derived from the standard Right Ascensions of clock stars from 12-hour groups observed during the years 1868–1876, and the Right Ascensions of the remaining *Nautical Almanac* stars are taken from the Nine-Year Catalogue itself. Also that the Declinations of the *Nautical Almanac* are those of the Nine-Year Catalogue corrected so as to depend on the refractions of Bessel's *Tabula Regiomontana*, with the corresponding value of the latitude of Greenwich. In the *Nautical Almanac* for 1883 the mean places of the Greenwich standard

* Mr. Hind informs me that from 1880 onwards, the place of *a Columba* has been derived from the Cape and Melbourne Catalogues. This reduces the total number of stars whose places are taken from the Greenwich Catalogues to 182.